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B62D 55/24

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US 3883191 A US 3858949 A US 3575474 A

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(54) Rubber crawler tracks with urethane inserts

(57) This invention relates to a rubber crawler track to be attached to a travelling type of agricultural, building machines and the like. The rubber crawler track is characterized in that the core members (4) provided for reinforcement are made of a special structure employing an elastic plastic of high degree of hardness instead of the metal member. The core members (4) are built in the rubber crawler track body. The outer circumferential layer which will be the ground side of the rubber crawler track is made of vulcanized rubber such as natural rubber, synthetic rubber or a combined rubber of natural and synthetic rubber together. The inner circumferential layer of the opposite side thereof is composed of urethane rubber, including coming off preventing protrusions.

FIG 2

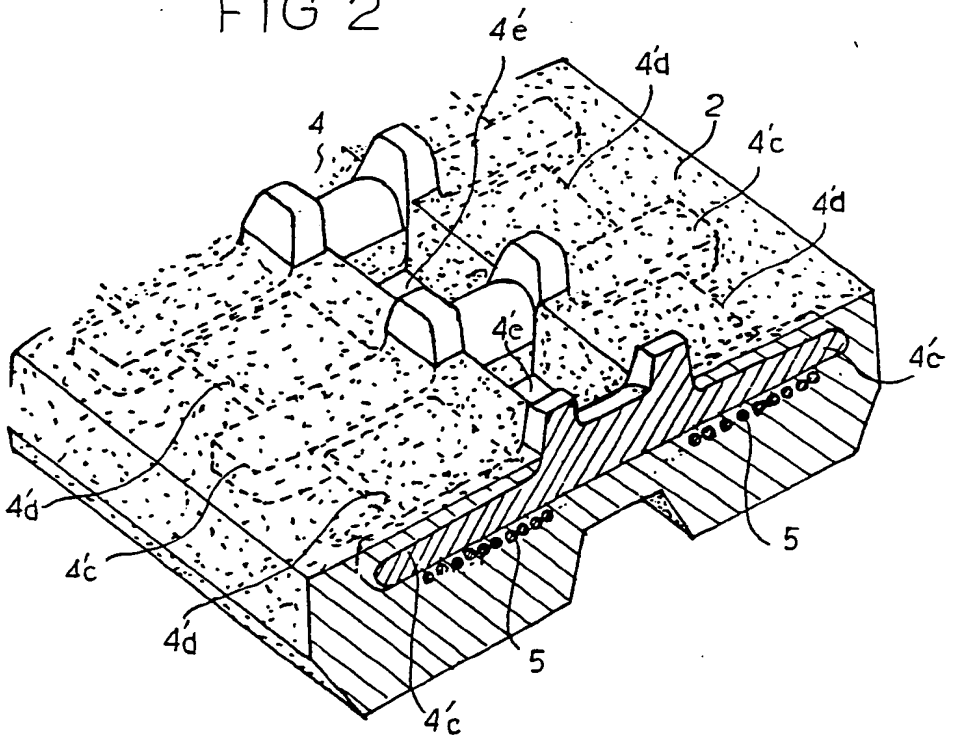

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FIG 1

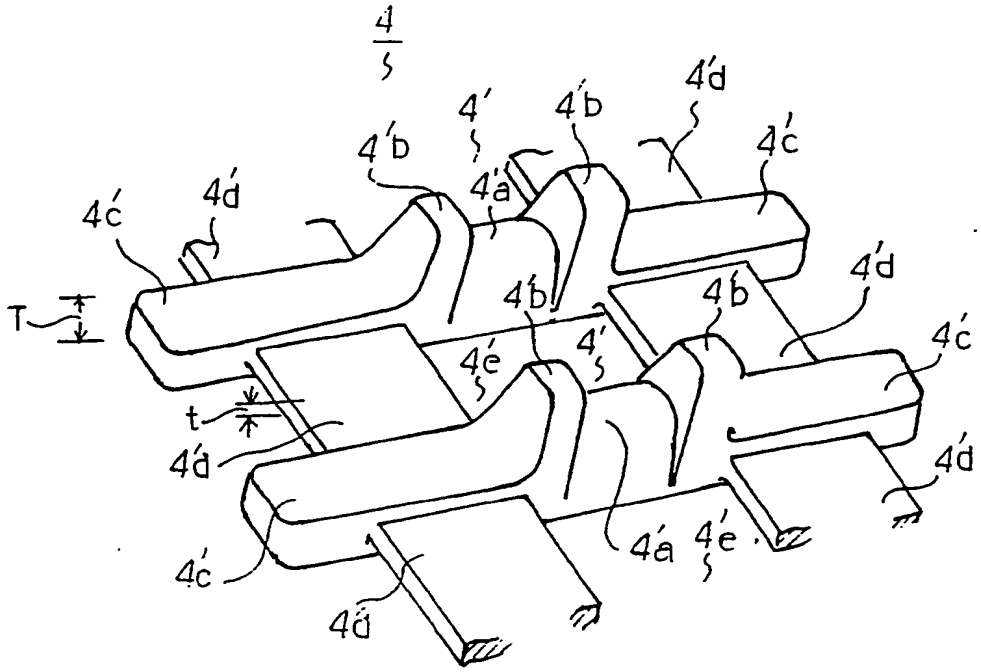


FIG 2

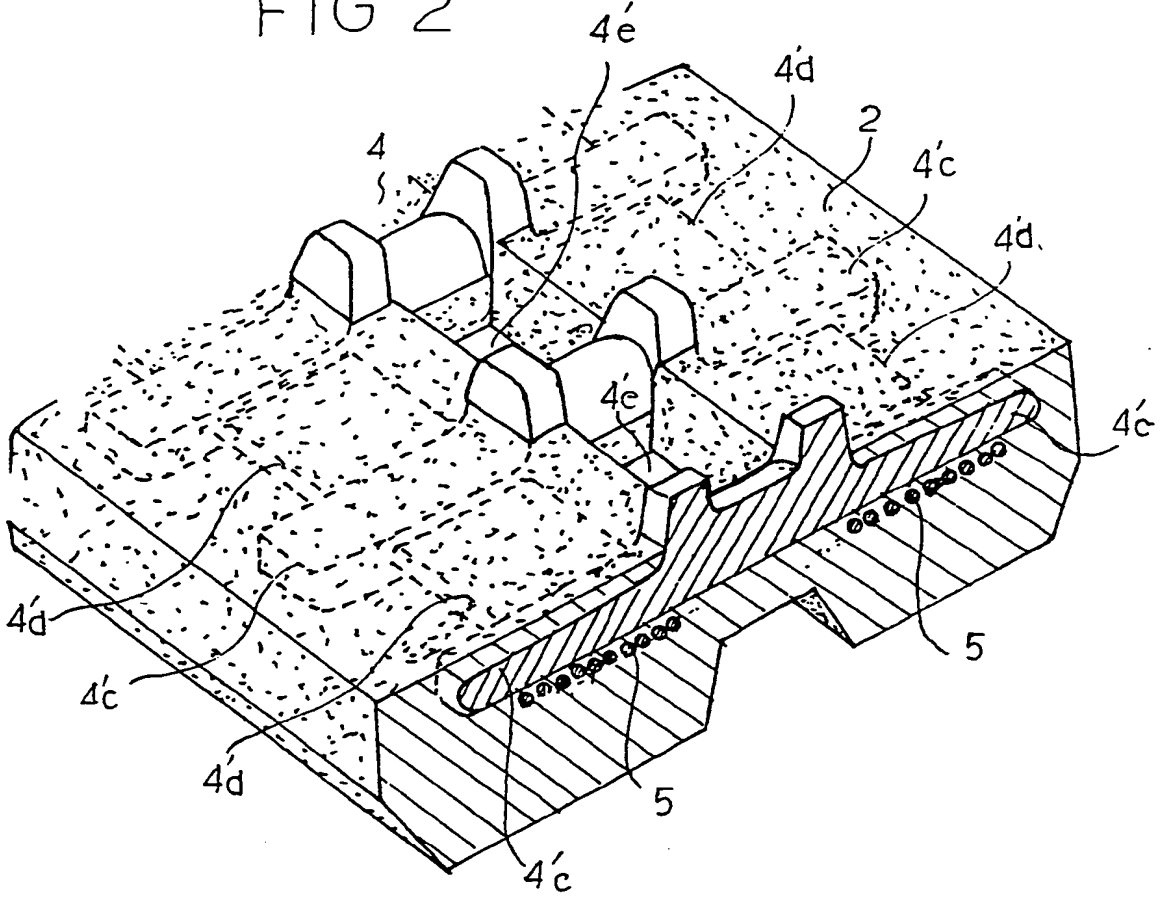


FIG 3 A

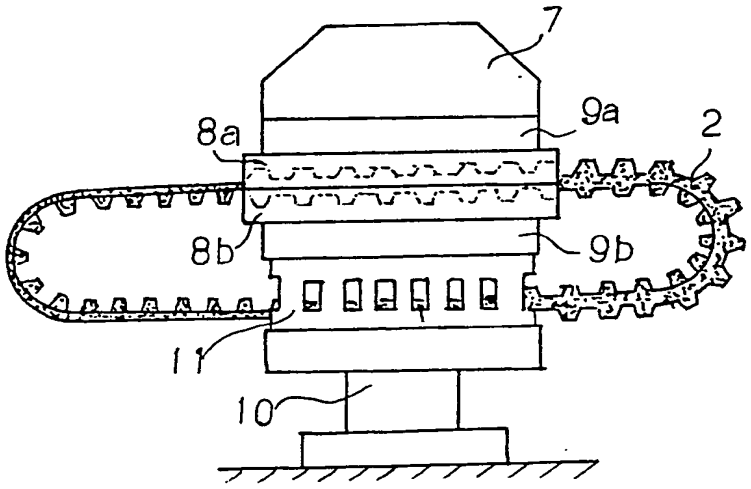


FIG 3 B

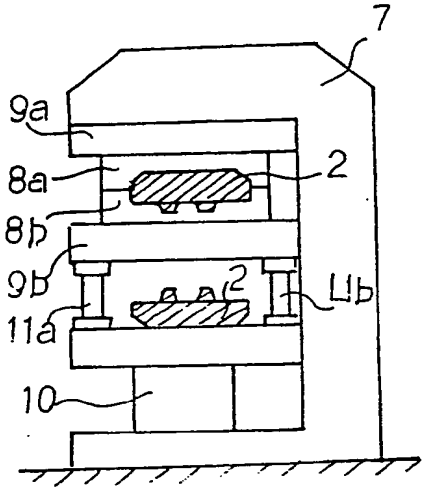


FIG 4

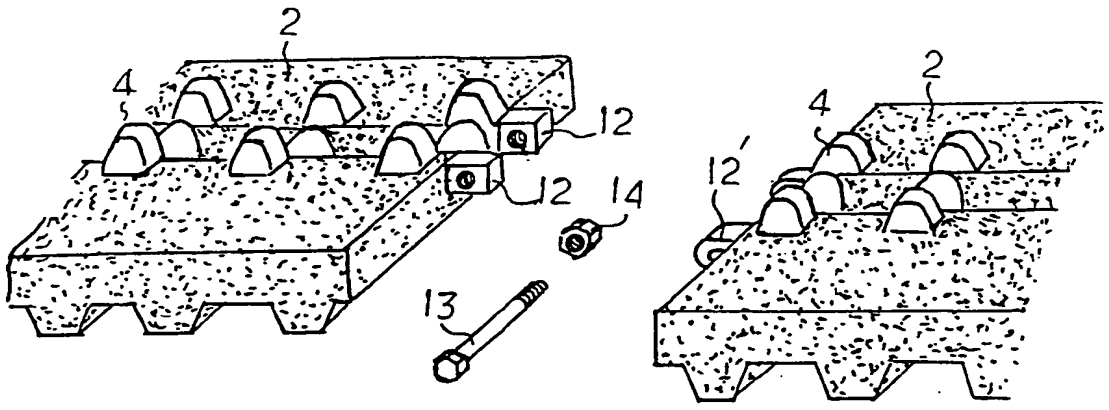


FIG 5

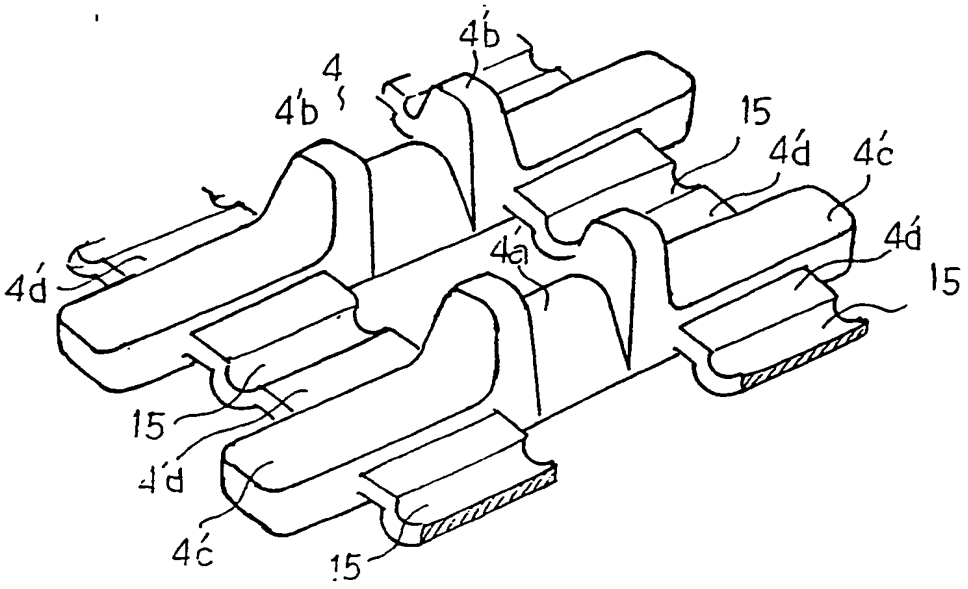


FIG 6

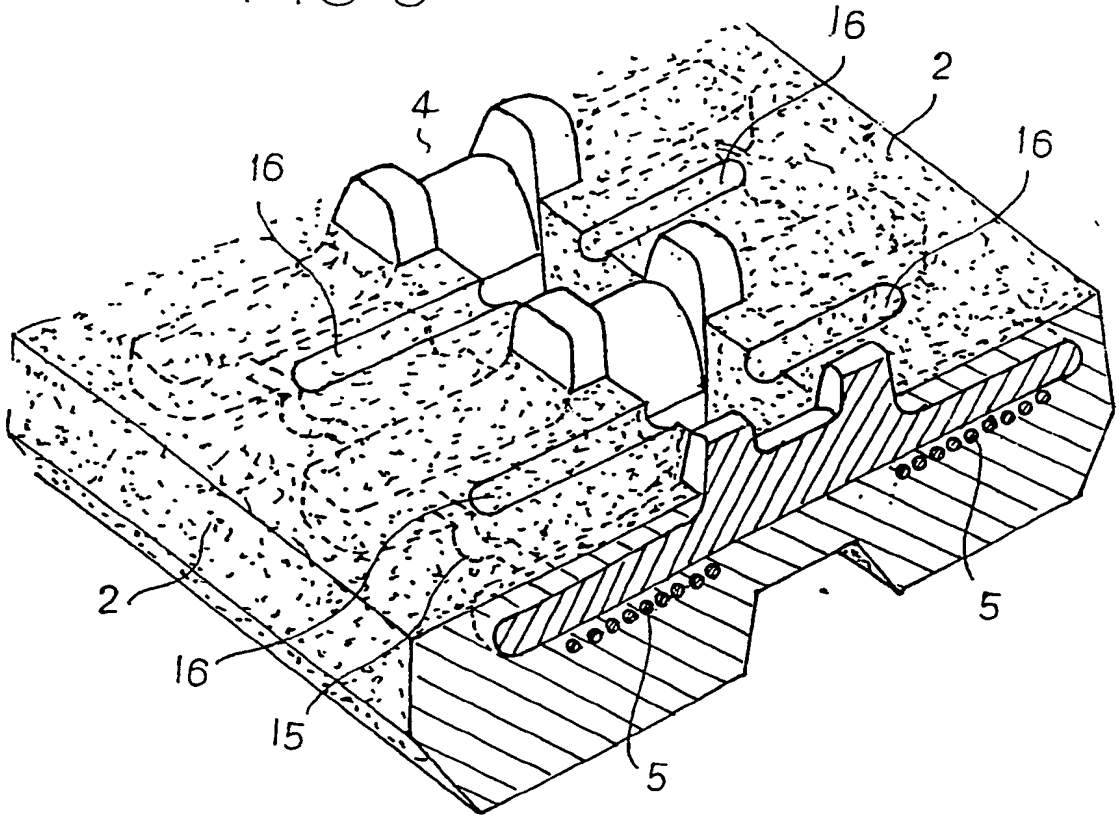


FIG 7

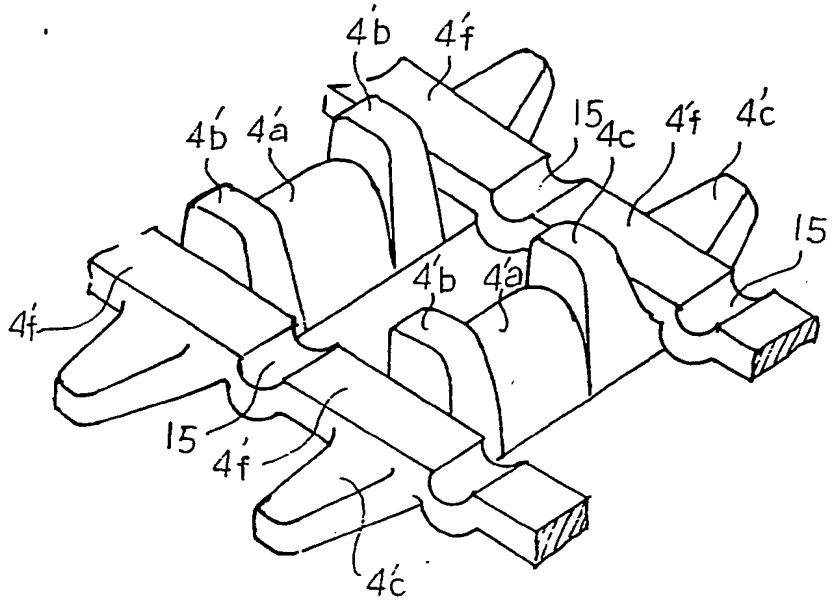


FIG 8

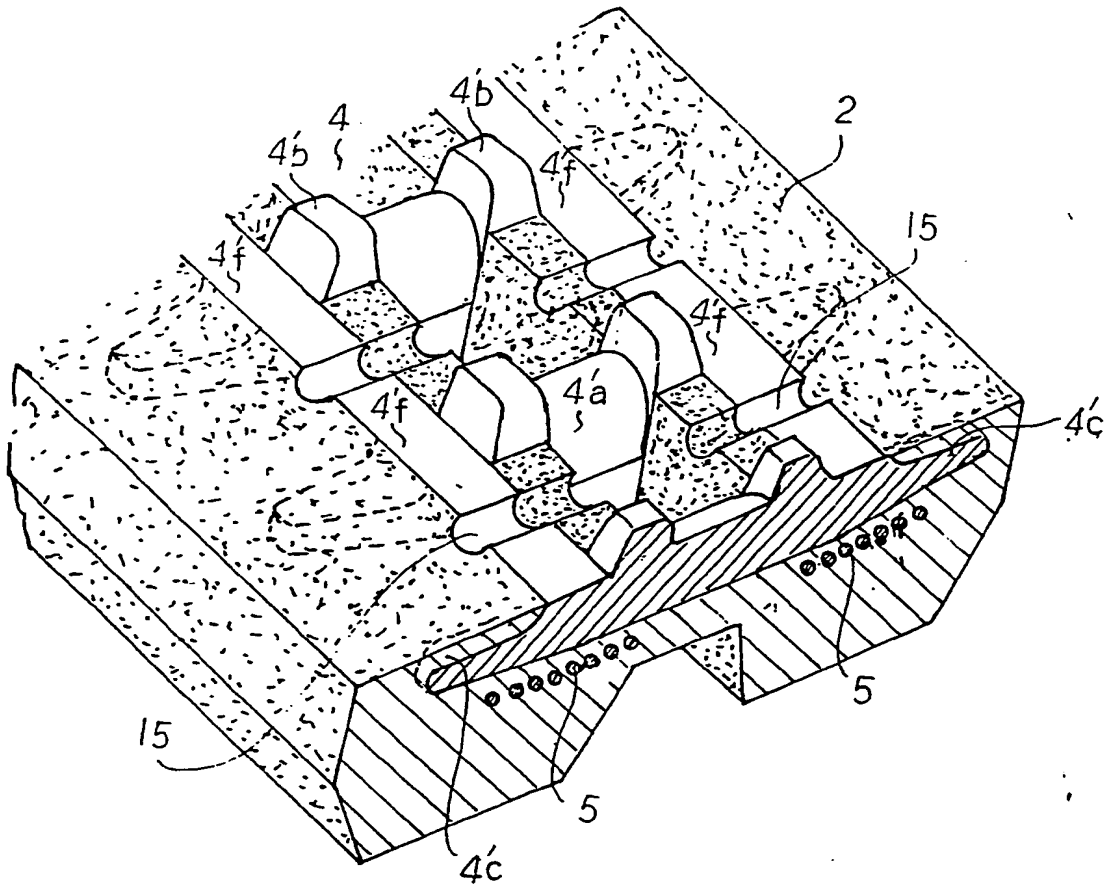


FIG 9

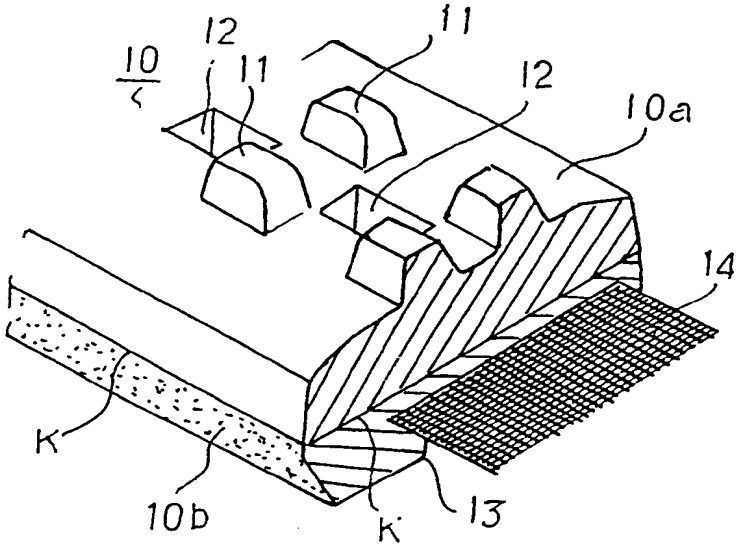


FIG 10A

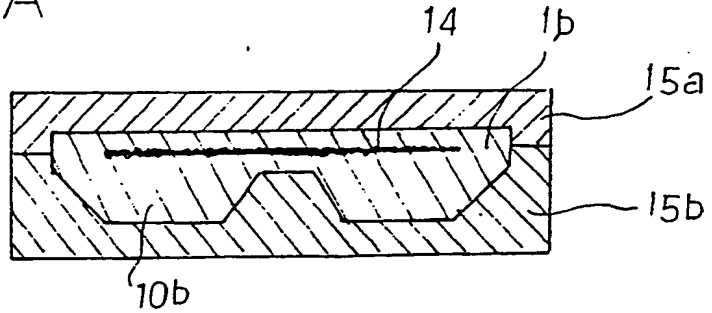


FIG 10B

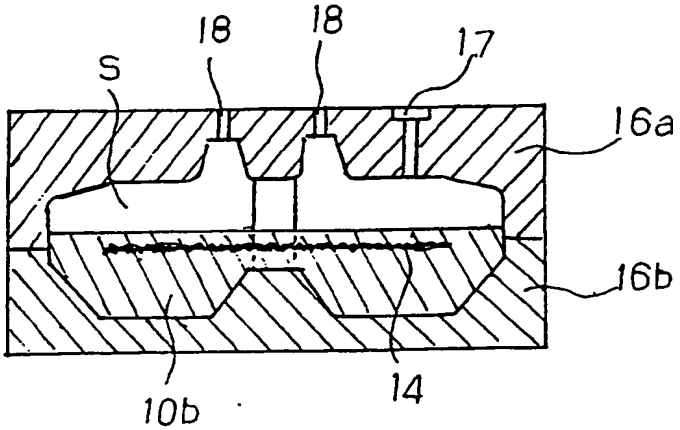


FIG 11

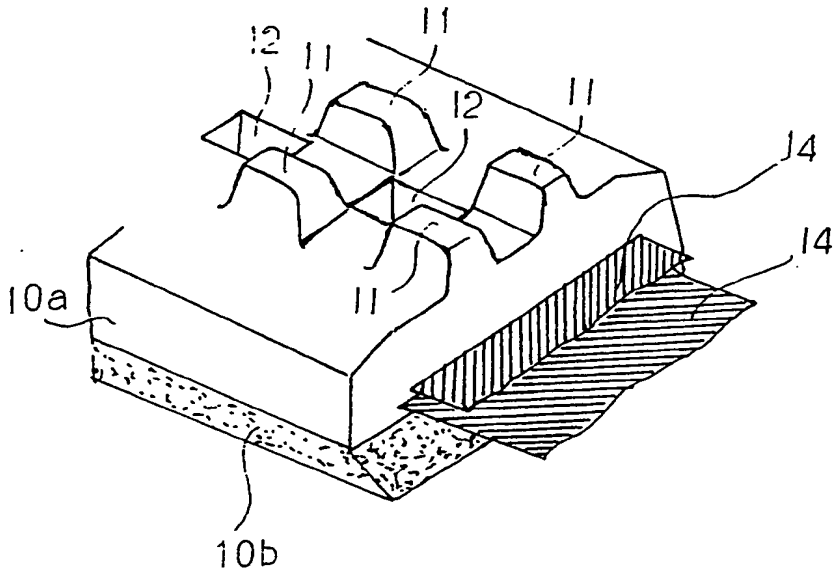


FIG 12

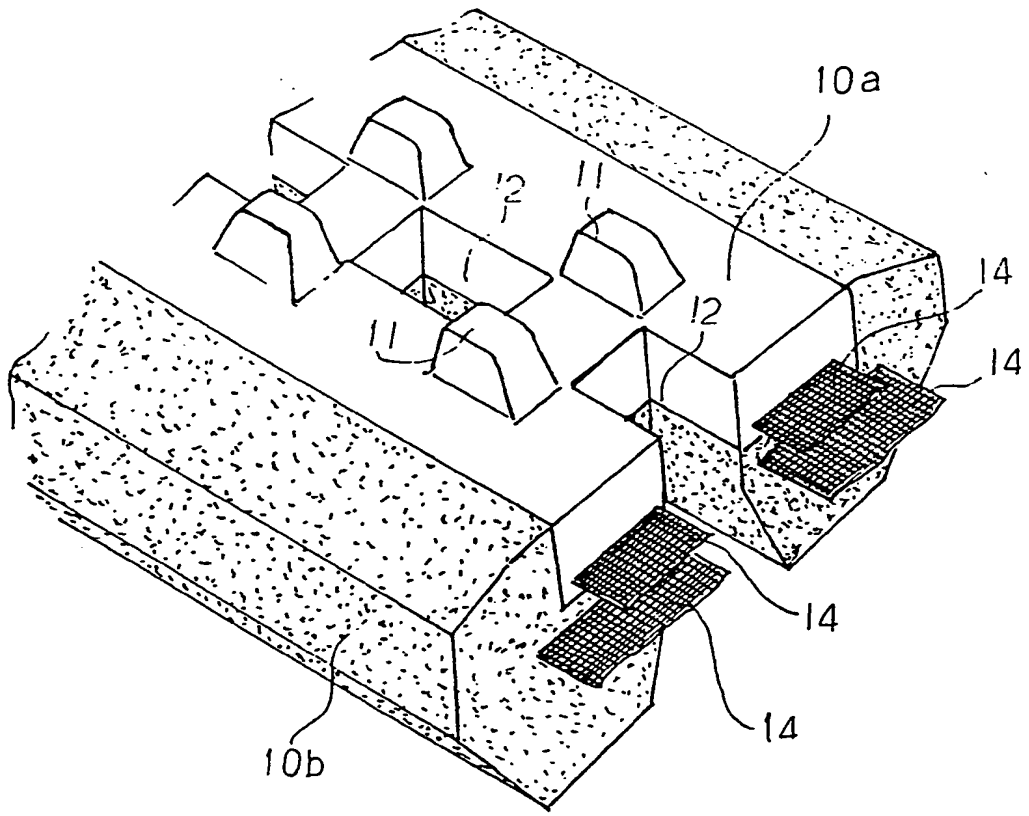


FIG 13

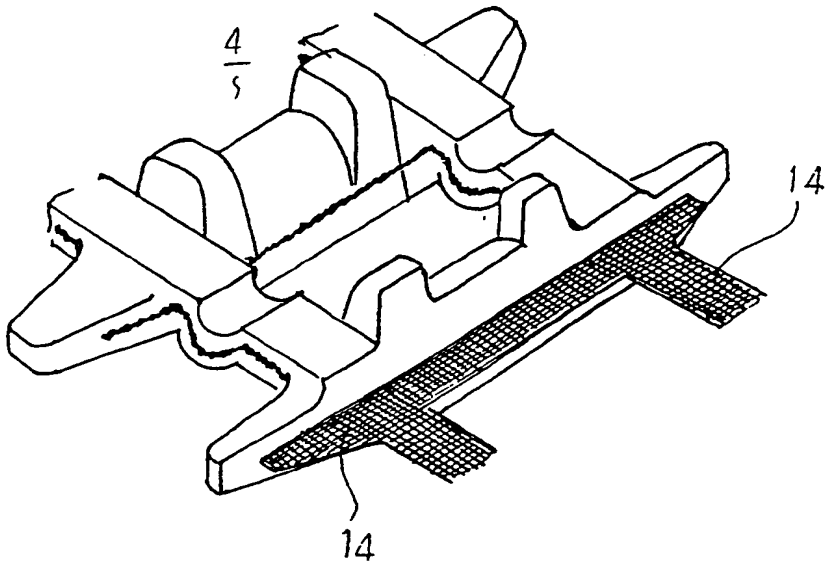


FIG 14

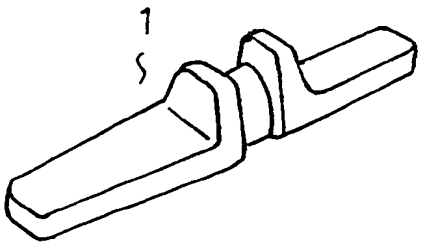


FIG 15

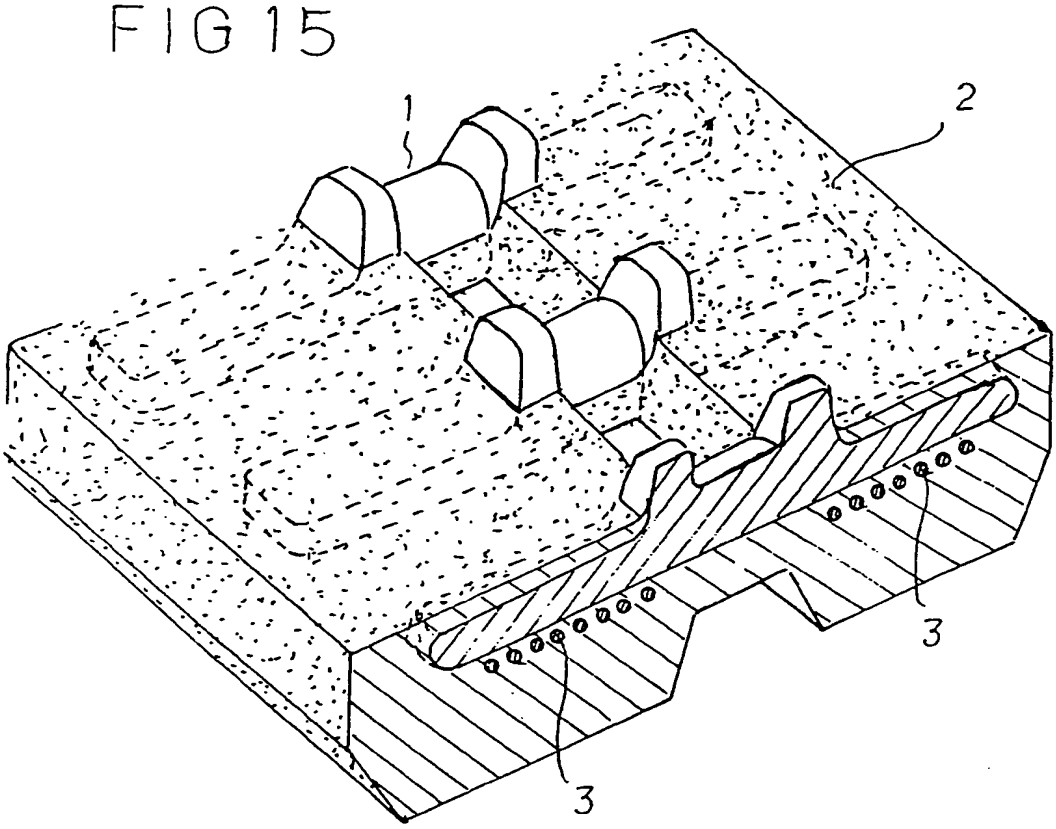
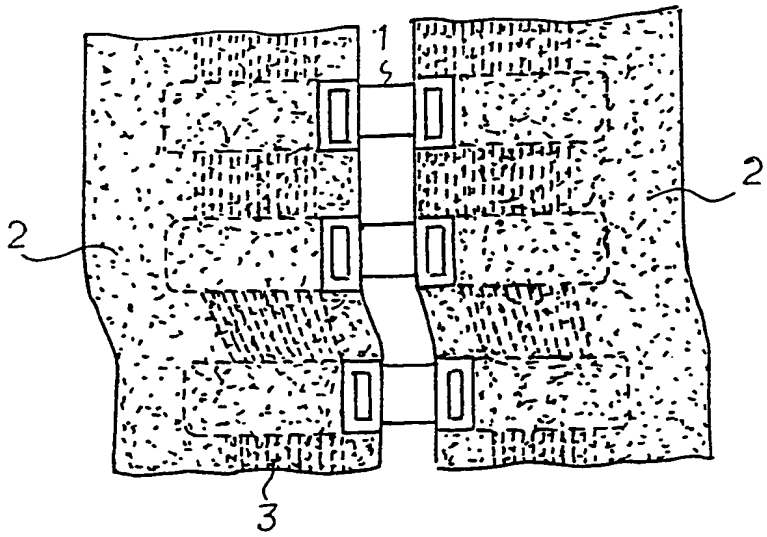


FIG 16



RUBBER CRAWLER TRACK

This invention relates to rubber crawler track to be attached to a travelling type of agricultural machines and building construction machines.

The conventional rubber crawler track is so composed that metal-made core members 1 shown in Fig. 14 are built in the rubber crawler track body 2 in the circumferential direction thereof with a certain fixed interval as shown in Fig. 15 and a number of steel cords 3 are provided at the ground side of the metal-made core members 1.

It has been recognized that in comparison with a steel-made caterpillar a rubber crawler track is furnished with many features and merits. Namely, the rubber crawler tracks have often been used where the lugs on the ground engaging side are made of rubber, thereby causing the surface of paved roads not to be damaged. However, it is necessary that a number of core metal and steel cords are built in the rubber

crawler track body to secure rigidity. Although the core member of the conventional rubber crawler tracks is made of metal, the weight of the whole rubber crawler track is unavoidably increased, and the travelling noise becomes large due to friction between the metal core members thereof and the metal-made drive wheel and roller wheels. In addition, the wearing thereof may be unavoidably increased.

A twisting such as shown in Fig. 16 often occurs in turning during travelling, thereby causing the crawler track to come off. This invention has been made in order to solve the problem in the prior art shown in the above. These and other objects will be made clearer in the ensuing description in which the invention is exemplified with reference to the drawings attached hereto.

Fig. 1 is a perspective view of a consecutive core member to be used in the invention;

Fig. 2 is a perspective view showing the state when the consecutive core member is built in the rubber crawler track;

Fig. 3 is a view showing the manufacturing state of the rubber crawler track, the view "A" thereof is the front elevation view and the view "B" thereof is a side elevation view;

Fig. 4 is an explanatory view showing the part of connection for making a rubber crawler track semi-endless;

Fig. 5 is a perspective view showing another example of the consecutive core member;

Fig. 6 is a perspective view showing the state that the consecutive core member of Fig. 5 is built in the rubber crawler track body;

Fig. 7 is a perspective view showing still another example of the consecutive core member;

Fig. 8 is a perspective view showing the state that the consecutive core member of Fig. 7 is built in the rubber crawler track body;

Fig. 9 is a perspective view showing that the ground side of the rubber crawler track and the inner surface thereof are made of different materials, the former is made of rubber and the latter is made of urethane resin;

Figs. 10 A and B are a view explaining the method of manufacture of the rubber crawler track of Fig. 9;

Fig. 11 is a perspective view of another example;

Fig. 12 is a partially perspective view showing still another example;

Fig. 13 is a partially broken perspective view showing that reinforcement cloth is built in the consecutive core member.

Fig. 14 is a perspective view of the conventional metal-made core member;

Fig. 15 is a perspective view of the conventional rubber crawler track in which metal-made core members are used, and

Fig. 16 is a view explaining the twisting phenomenon in the conventional rubber crawler track.

Fig. 1 is a perspective view of consecutive core member 4 to be used in the invention. The consecutive core member is so composed that a pair of horn portions 4'b and 4'b can be provided oppositely each other to be protruded, putting the central engaging portion 4'a therebetween, the unit core member 4', 4', ... which are furnished with wing portions 4'c, 4'c of a fixed width and length at the outside thereof can be placed in parallelism each other with a certain fixed interval, and engaging holes 4'e, 4'e, ... can be formed between the central engaging portions by connecting respective wing portions of respective unit core members 4', 4', ... by means of band members 4'd, 4'd. In addition, these members are integrally molded to be consecutive with elastic plastic material of high degree of hardness.

At this time, the wing portions 4'c, 4'c are molded to be of comparatively large thickness "T" and the band members 4'd, 4'd are done to be of thin thickness "t". The dimension of the thickness is

designed to proper values according to the weight of an agricultural machine, a building construction machine and the like. However, the ratio of these dimensions is roughly T:t = 1: 1/2. One of the examples of these dimensions is T = 25mm and t = 12mm, and the material of synthetic resin used herein is polyurethane resin.

Fig. 2 is a perspective view showing the state when the consecutive core members 4 so composed as shown in the above are built in the rubber crawler track. The wing portions 4'c, 4'c which are made to be thick have high rigidity and can function as well as the conventional metal-made core member. To the contrary, the right and left band members 4'd, 4'd have proper flexibility and rigidity and can secure the engagement and rotation with the drive wheel and idle wheel. As the right and left band members 4'd, 4'd widely exist consecutively between the forward and the backward wing portions 4'c, 4'c, these portions have rigidity in the width direction of the crawler track, thereby causing the twisting hardly to occur. Steel cords 5, 5 are built in the rubber crawler track body 2 on both sides of the engaging hole 4'e. At

this time, the steel cords 5, 5 may be built in the right and left band members 4'd, 4'd of the consecutive core member 4. These steel cords are used as anti-elongating member, and may be of linear members, etc. consisting of polyamid fiber of aromatic group other than steel. Besides, metal pieces may be properly inserted in respective horn portions 4'b, 4'b of the unit core members 4', 4', ... in order to reinforce the rigidity thereof.

In this invention, the material of the consecutive core member 4 is elastic plastic of high degree of hardness such as polyurethane resin. For instance, polyurethane resin of a casting type is poured, hardened and molded in a metal die having such a cavity as to mold the consecutive core members. In this case, if such linear members as steel cords, etc. are arranged in a cavity in advance before the material is poured, it is possible to lay steel cords, etc. in the consecutive core members at the same time.

The method of manufacturing a rubber crawler track by laying consecutive core members 4 in the rubber body according to the present invention is the

same as the conventional method for manufacturing a rubber crawler track. That is, consecutive core members and non-vulcanized rubber, etc. are arranged in a metal die, heated and vulcanized for an appointed period of time. In this case, if a surface treatment is given to the consecutive core members, the cementing with the rubber body can be made stronger.

Contrarily, there is another method for manufacturing, that is, the rubber crawler track body is firstly molded. Thereafter, polyurethane resin is poured and hardened in a space secured in the body. In this method, after a rubber crawler track is molded in which the same model as a consecutive core member is built in, the model is eliminated. Then, polyurethane resin is given into the space (cavity) from which the model has been removed and hardened. To make it easier to take out the model, a method of the disassembling type can be adopted.

On the other hand, consecutive core member molded to be an endless band can be produced by using a swan-neck press equipment 7 as well as the conventional rubber crawler track.

Figs. 3 A (front elevation view) and B (side elevation view) show this state of production. Upper and lower metal dies are indicated at 8a and 8b, respectively. Upper and lower hot plates are also indicated at 9a and 9b, respectively. A cylinder to elevate and lower the lower die and the lower hot plate is indicated at 10. Spacers 11a and 11b can allow endless consecutive core members and vulcanized rubber crawler track body to pass through. Consecutive core member is put between the upper and lower metal dies opened by the lowering movement of the cylinder 10 and then vulcanized with a non-vulcanized rubber. The endless consecutive core member can be produced by repeating the above actions several times.

Contrarily, a band-like crawler track is molded by using a metal die of a long-sized press, and a semi-endless crawler track of a removable type can be made by connecting the portion of connection which is provided at both ends of the consecutive core member, by means of a bolt 13 and a nut 14. Fig. 4 shows this state of production.

In the example shown in Fig. 5, dent portions 15 are provided in the band member of the consecutive core member 4 and dent grooves 16 are provided at the front side of the inner circumferential side of the rubber crawler track body 2, corresponding to the above dent portions 15 as shown in Fig. 6 when laying the dent portions 15 under the rubber crawler track body 2, thereby causing compression stress, which may be produced on the inner circumferential side of the rubber crawler track body on rotation, to be easily dispersed, and causing the engagement and turning with the drive wheel and the idle wheel to be secured.

Fig. 7 is a perspective view of the consecutive core member in another example, and Fig. 8 is a view showing the state that the consecutive core members are built in the rubber crawler track body. This example is so composed that the shoulder portions 4'f which will be the contacting surface with roller wheels can be provided at the outside of the horn portions of the consecutive core members and extend in the circumferential direction thereof, thereby causing the drop of the roller wheels in travelling to be

decreased as much as possible and the travelling vibration to be greatly improved.

In all the above examples of the embodiment, the consecutive core members 4 of elastic plastic material of high degree of hardness such as polyurethane resin, etc. are built in the rubber crawler track body. The same effect as shown in the above can be secured with the other example of the embodiment without the consecutive core members, according to this invention. That is, the whole outer circumferential layer, which will be the ground side of the rubber crawler track body, is composed of vulcanized rubber consisting of natural rubber, etc, while the whole inner circumferential layer of the non-ground side is composed of a different material like urethane resin. A synthetic rubber or a combination of the natural rubber and the synthetic rubber, etc. may be used in addition to the natural rubber as material of the above vulcanized rubber.

Fig. 9 is a perspective view showing the rubber crawler track 10 so composed as shown in the above. The inner circumferential layer consisting of urethane

rubber is indicated at 10a, and the outer circumferential layer consisting of the vulcanized rubber like natural rubber, etc. is indicated at 10b. At this time, a pair of horn-like protrusions 11, 11 are provided at the central portions of the inner circumferential layer 10 with a certain fixed interval and are for guiding the drive wheel and idle wheel so that they cannot come off. They are integrally molded with urethane rubber. Also, the engaging notches 12 in which the claws of the drive wheel are inserted are integrally molded together therewith. Lugs 13 are protruded toward the ground side of the outer circumferential layer 10b, and reinforcement cloth 14 is provided in the vicinity of the boundary "k" between the inner circumferential layer 10a and the outer circumferential layer 10b. The numeral 14 is the reinforcement cloth which may be mainly woven with carbon fiber fabric, aramid fiber fabric, polyarylate fiber fabric, or other fabric which hardly elongates because of its high strength and high elasticity ratio is used. Moreover, nylon fiber fabric or polyester fiber fabric which has high strength but is somewhat inferior to the above carbon fiber fabric, etc. in the ratio of elasticity may be used. Also, these woven

cloths may be of either single material of the above or a combination thereof, and they can be built in with the fiber cords thereof rowed in good order.

The urethane rubber of the inner circumferential layer 10a in this preferred embodiment is good in durability for repeated compression but it is not so good in durability for repeated elongation. Therefore, this urethane rubber is to be provided at the compression side of the inner circumferential layer. Contrarily, as the outer circumferential layer 10b consisting of vulcanized rubber such as natural rubber, etc. is good for durability for both compression and elongation, there is no problem. Also, it is preferable that the reinforcement cloth 14 is built in in the vicinity of the boundary "k" therebetween. The reason is that the reinforcement cloth 14 contributes to lightening radical elongation and contraction in the vicinity of the boundary "k" between the inner circumferential layer 10a and the outer circumferential layer 10b. That is, such a layer so as not to be elongated even at the turning point with the drive wheel is composed by applying the reinforcement cloth 14 in the crawler track body,

thereby causing the inner circumferential side to be compressed and the outer circumferential side to be elongated, centering around the reinforcement cloth 14. Moreover, the boundary "k" where the reinforcement cloth 14 is provided is made almost free from any elongation and contraction, thereby causing the portion to be hardly distorted. Especially, as minute distortions can be dispersed by means of this reinforcement cloth 14, the boundary peel-off will be hardly produced.

Fig. 10 shows the method of production of the above rubber crawler track 10. Firstly, as shown in Fig. 10(A), non-vulcanized rubber and reinforcement cloth 14 are placed between the upper die 15a and the lower die 15b as well as in the method of production of the usual rubber crawler track, heated and pressurized for an appointed period of time, thereby causing the outer circumferential layer 10b to be formed. Next, as shown in Fig. 10(B), the outer circumferential layer 10b so formed as shown in the above is placed between the upper die 16a and the lower die 16b for casting resin. Thereafter, two-liquid mixed type liquefied urethane rubber is

poured and filled through a supplying port 17 in the space "S" which is formed above the outer circumferential layer 10b, hardened and aged for an appointed period of time, thereby causing the inner circumferential layer 10a to be formed. In the same figure, an air blow-out port is indicated at 18. In the above production, it is possible that organic chloride-oriented primer is coated for treatment in advance to the cementing surface between the outer circumferential layer 10b and the inner circumferential layer 10a.

In the above example of the embodiment, a single reinforcement cloth 14 is used. In addition, the reinforcement cloth 14 can be used in only the inner circumferential layer or in both the inner circumferential layer and the outer circumferential layer. And a plurality of reinforcement cloths 14 can also be used instead. In any case, the reinforcement cloth is built in the vicinity of the boundary.

The inner circumferential layer 10a is reinforced to cause the engaging holes 4'e to be hardly cracked or damaged if the reinforcement cloth 14 is built in the inner circumferential layer 10a. If the above

reinforcement cloth 14 is devised so as to be biased and arranged in the inner circumferential layer 10a as shown in Fig. 11, it is further possible that the rubber crawler track is much more free from cracks and damage.

Fig. 12 shows another arrangement of the above embodiment. In this example, the inner circumferential layer 10a of which lateral width is made smaller than the lateral width of the crawler track body 10 is built in the outer circumferential layer 10b. This can contribute to decreasing the amount of use of urethane rubber to form the inner circumferential layer 10a, thereby causing the cost of production to be lessened. In addition, as both the right and the left ends are made of rubber quality, those with which the crawler track may be brought into contact are hardly damaged.

The reinforcement cloth 14 explained in the above can be used for the consecutive core members 4 described at the beginning of this specification for further strengthening the strength thereof. Fig. 13 shows this state. The rubber crawler track in the

above example of the embodiment is provided with sprocket holes. However, as rubber crawler track not having such sprocket holes is available, the present invention is not limited to the above embodiments furnished with sprocket holes.

As metal-made core members are not used in the invention, the weight of the whole rubber crawler track can be decreased, and travelling noises due to friction between the drive wheel and roller wheels can be remarkably lessened and the wearing thereof can be also reduced. Therefore, the invention can bring remarkable effects.

CLAIMS

1. A rubber crawler track comprising consecutive core members built into a crawler track body in the form of a layer of rubber,
each consecutive core member carrying a pair of opposed horn portions protruding out from the rubber layer, having a pair of outwardly directed wing portions of uniform width and depth, and being connected via its wing portions to the next adjacent core member by means of band members, the consecutive core members and band members being moulded of an elastic plastic material having a high degree of hardness.

2. A rubber crawler track according to claim 1, wherein a shoulder portion is formed between the opposed horn portions of each unit core member and protrudes from the rubber layer of the rubber crawler track body so that the shoulder portion can become the contacting surface with roller wheels in travelling.

3. A rubber crawler track according to claim 1, wherein a dent portion is provided at the middle portion of a band member by which the wing portions of the adjacent single unit core members are connected.

4. A rubber crawler track according to claim 1, wherein a reinforcement cloth is built in the consecutive core members.

5. A rubber crawler track having an inner circumferential layer including a series of pairs of horn-like protrusions which are formed along the inner central portion at regular intervals for preventing roller wheels and idle wheels from coming off, which inner circumferential layer is made of urethane rubber, an outer circumferential layer opposite thereto on the ground engaging side, which is made of a different vulcanized rubber for example natural rubber, and a reinforcement cloth of high strength is arranged in the vicinity of the boundary of either or both of the inner circumferential layer and the outer circumferential layer.

6. A rubber crawler track comprising all of the features of claims 1 and 5.

7. A rubber crawler track substantially as herein described with reference to the accompanying diagrammatic drawings.

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